(No Model.)

E. A. COLBY.

PROCESS OF MELTING, REFINING, AND CASTING METALS.

No. 428,552. Patented May 20, 1890.

Fig. 1.

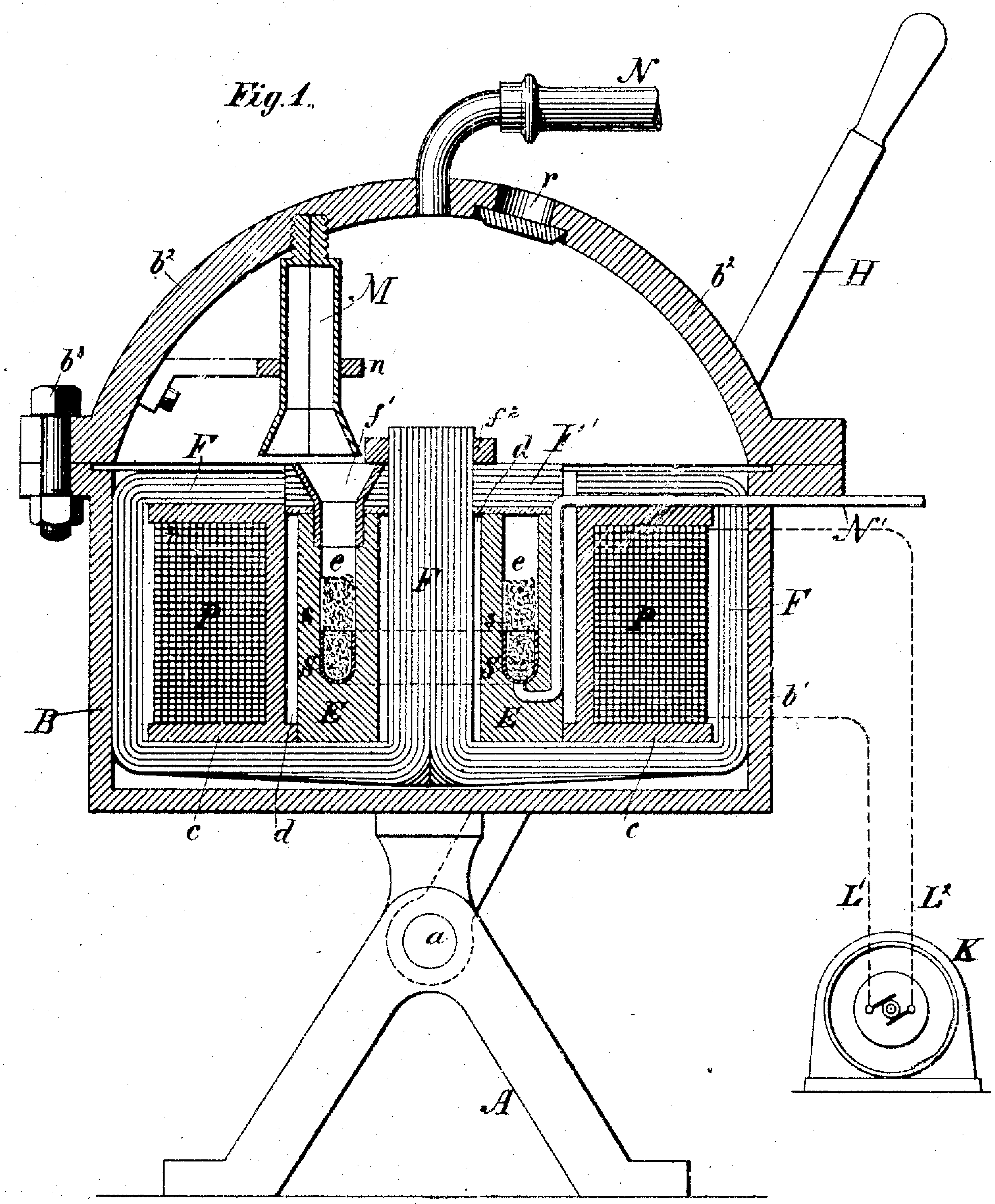
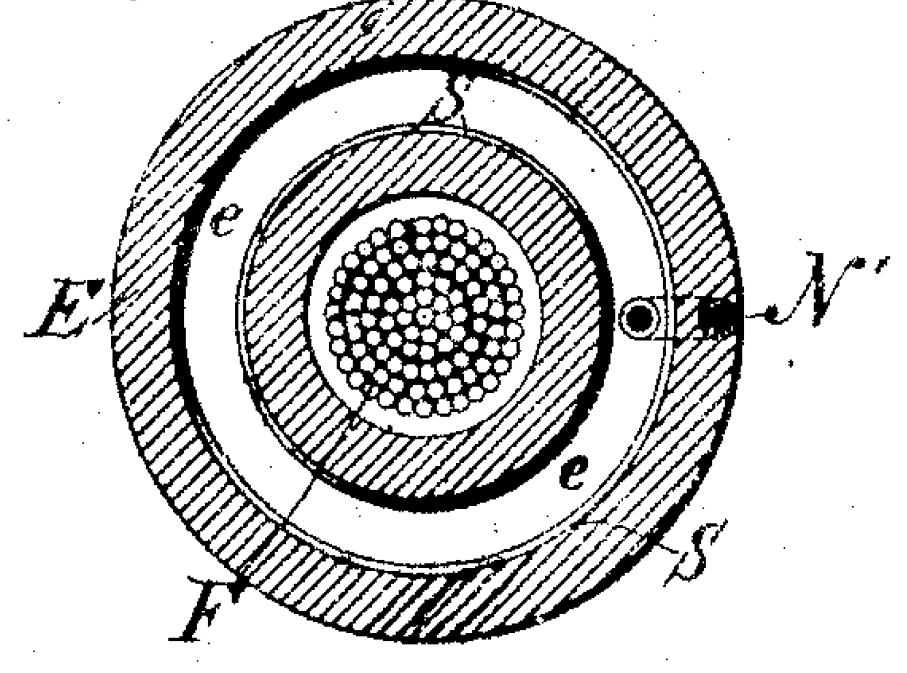


Fig. 2.



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PROCESS OF MELTING, REFINING, AND CASTING METALS.

SPECIFICATION forming part of Letters Patent No. 428,552, dated May 20, 1890.

Application filed December 17, 1887. Serial No. 258,172. (No model.)

To all whom it may concern:

Be it known that I, EDWARD A. COLBY, a citizen of the United States, residing at New Haven, in the county of New Haven, in the State of Connecticut, have invented certain new and useful Improvements in the Process of Melting, Refining, and Casting Metals, of which the following is a specification.

The invention relates to a method of melting, refining, and casting metals and non-metallic substances.

The object of the invention is, primarily, to melt, refine, or cast certain substances by electricity, and, secondly, to accomplish this under conditions which prevent deterioration of the metals while in a state of fusion, as by carrying on the process in a rarefied or artificial atmosphere.

The invention is of especial value in refining and casting various metals in such manner that they will be free from blisters, pin-holes, and occluded gases. Many of the metals have a high absorptive capacity for gases. This affinity is especially manifested at elevated temperatures between the more refractory metals and hydrogen. Upon solidification from the molten state a portion of these occluded gases is retained; but the larger portion is expelled violently if the metal cools rapidly, sometimes ejecting molten particles, and creates in its exit minute fissures, termed "pin-holes," or, in the aggregate, blisters throughout the mass. Castings made in the ordinary manner are therefore unhomogeneous in structure. This defect may be greatly magnified in castings of platinum and its allied refractory metals, which are melted with the oxyhydrogen flame, because, it being impracticable to supply the compound gases of the flame in the exact proportion of their affinitive volumes, an excess of hydrogen is generally present, free to be absorbed by the molten metals. An unhomogeneous structure, while perhaps of slight importance in any metallic mass, may entail serious consequences when, as for example, the metal is drawn into a fine wire, as any defect in structure then becomes a hidden source of trouble. This is especially true where, as in the manufacture of incandescent electric lamps, it is of the utmost importance that the platinum sealed in the glass should be of uniform density. In this specific case the slightest fissure in the platinum wires serves as a reservoir and possibly as a channel for the entrance of gases capable of destructive union with the carbon filaments.

Many laboratory experiments have been made to produce a high grade of metallic castings for specific uses; but the beneficial results attained have involved methods too expensive for commercial adoption.

This invention consists in heating metals and refining them in a closed and gas-exhausted containing-vessel by means of the inductive action of electric currents, and in casting them while so heated and deprived of occluded gases into ingots.

The invention will be described in connection with the accompanying drawings, in which—

Figure 1 is a vertical transverse section, and Fig. 2 is a plan view, of a device adapted to the purpose of the invention.

Referring to the figures, A represents a suitable stand, upon which the furnace B is supported. This furnace may be carried upon a trunnion a. It consists, in this instance, of an outer casing b', containing an inductive device, presently to be described. The case b' is provided with a cover b^2, which may be securely fastened down by bolts b^3. The cover and case thus form an air-tight chamber. Within this chamber there is placed the induction device, and this consists of a primary coil P, a secondary conductor S, and a core F. The coil P is designed to be included in the circuit of a generator K, delivering an alternating, intermittent, or pulsatory electric current. This coil consists of suitable conducting-wire insulated with fire-proof material—such, for instance, as asbestus. It is wound upon a spool c, which is preferably of refractory insulating material—such, for instance, as slate. Within the coil P there is placed an annular block E of non-electric conducting material—such, for instance, as fire-clay or lime capable of withstanding great heat. This may be separated from the coil P and iron core F by air-spaces d. The block C contains an annular groove e, in which there is set the annular trough or receptacle S, which is designed to receive the material to be heated or melted or otherwise operated upon. Such material may be various chemical substances, organic or inorganic, having no chemical affinity for the containing-receptacle. The trough S is designed to constitute the secondary coil of the converter or induction coil; but if the substance to be acted upon is itself a conductor of electricity, it also may constitute, partially or entirely, the secondary coil, in which latter case the trough is not used.

For the purpose of better conveying the electric energy from the coil P to the conductor S the core F is employed. This may consist of soft-iron wires, which are preferably electrically insulated from each other to a greater or less extent. These wires extend through the center of the block E and across the bottom of the coil P, and thence around the sides and across the top, as shown. The top of the block E is preferably covered by a disk F', which is removable; but when it is in position it serves to complete the magnet-circuit through the core F. The disk F' is also composed, preferably, of radiating insulated soft-iron wires. The under side of the disk F' may be lined with some refractory material—such, for instance, as fire-clay or lime.

The disk F' is constructed with one or more openings f', for the purpose of allowing the material to be operated upon to be readily placed in the annular space e. The disk may be secured in place by a nut or washer f^2 passing around the central portion of the core F.

It is designed that the primary coil P shall be connected in an electric circuit by means of conductors L' and L^2, leading from the generator K or other suitable source of alternating, intermittent, or pulsatory currents of high potential. Currents will thus be induced in the secondary circuit of the annular trough or receptacle S. Such current will cause this trough to be heated and thus any material—such as metals and non-conducting chemical substances or liquids—placed in the trough, as indicated at s, will be raised to a temperature dependent upon that of the trough. As there is but a single turn of the secondary circuit, the current will be of low intensity but of great quantity, and thus the temperature may be raised to any required degree.

Complete control of the temperature is secured by any of the usual devices for regulating the current in the primary circuit. Usually it is necessary that the volume of the substance contained in the receptacle S should be such that when heated or fused it shall exceed the capacity of that receptacle, so that no injury will come to it from overheating.

This device is especially useful in melting non-conductors of electricity; but it may also be employed in connection with conducting materials. When the metals themselves are to serve as the secondary circuit, the trough S may be dispensed with in some instances, and the currents induced directly in the metals.

The cover b^2 may be applied to the case b' after the substance is in position, and if it is desired to treat the substance in a rarefied atmosphere the air may be exhausted by means of a vacuum-pump applied to a tube N leading through the cover. After the natural air has been exhausted, together with the gas which comes from the substance when heated, additional gas may be forced by a pump into the chamber through the inlet N', preferably leading into the lower portion of the containing-vessel S, and thus up through the melted substance. Gases may be employed which have a chemical affinity for the impurities contained in the substance being operated upon, or which form, with the substances under treatment, definite desired compounds. The resultant gaseous products are then removed from the chamber by the vacuum-pump. When the substance has been sufficiently treated, the entire furnace may be turned upon the trunnion a by means of a handle or lever H, and, if desired, the vacuum-pump may still be in operation. The substance will then be caused to flow into a mold M, which is fastened to the cover and held in position above one of the openings f', by means of a support n, fastened to the cover.

A peep-hole r, closed by a glass disk, may be formed in the cover at a suitable point for observing the operation.

I claim as my invention—

1. The hereinbefore-described process of electrically melting and refining metals and other substances, which consists in heating the entire mass of the substance in a retaining-receptacle by inductively establishing electrical currents in the substance or the receptacle, and thus heating the substances to and retaining them at the desired temperature.

2. The hereinbefore-described process of electrically melting and refining conducting substances, which consists in establishing electric currents within the same by inductive action until the metal is brought to a molten condition and then casting the same.

3. The hereinbefore-described process of melting electric conducting substances, which consists in creating a rarefied or equivalent atmosphere in a closed chamber, heating the entire mass of the substance to the point of fusion in such atmosphere by inductively establishing electrical currents therein, and casting or operating upon the substances in such atmosphere.

In testimony whereof I have hereunto subscribed my name this 12th day of December, A. D. 1887.

EDWARD A. COLBY.

Witnesses:
DANL. W. EDGECOMB,
JENNIE P. ASHLEY.